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Kachlic

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[45] **Date of Patent: Aug. 17, 1993**

[54] **ELECTRICAL CONNECTOR ASSEMBLIES**

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[73] Assignee: **Molex Incorporated**, Lisle, Ill.

[21] Appl. No.: **929,036**

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Related U.S. Application Data

[60] Division of Ser. No. 870,728, Apr. 15, 1992, Pat. No. 5,171,161, which is a continuation of Ser. No. 698,746, May 9, 1991, abandoned.

[51] **Int. Cl.**[5] **H01R 13/648**

[52] **U.S. Cl.** **439/607**; 439/701; 439/79

[58] **Field of Search** 439/79, 80, 81, 95, 439/108, 607–610, 677, 680, 701, 731

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Primary Examiner—Larry I. Schwartz
Assistant Examiner—Khiem Nguyen
Attorney, Agent, or Firm—Charles S. Cohen

[57] **ABSTRACT**

An electrical connector system is disclosed and includes a plug connector assembly mateable with a right angle header connector assembly. The plug connector assembly includes a plurality of terminal-receiving modules juxtaposed in a nested array in a cavity in a housing. The right angle header connector assembly includes a plurality of generally flat terminal modules nested within a cavity in a housing in a side-by-side relationship. Each terminal module of the header connector assembly includes a plurality of generally coplanar flat terminals surrounded and maintained in a desire array by an overmolded module encasement. The terminals have opposite terminal portions projecting from the encasement. Both the plug connector assembly and the header connector assembly are shielded connectors and each include a shield about a substantial portion of the respective connector assembly. The connector assemblies are held in mated condition by latches which are actuated by a cover mounted for relative movement about the plug connector assembly.

7 Claims, 5 Drawing Sheets

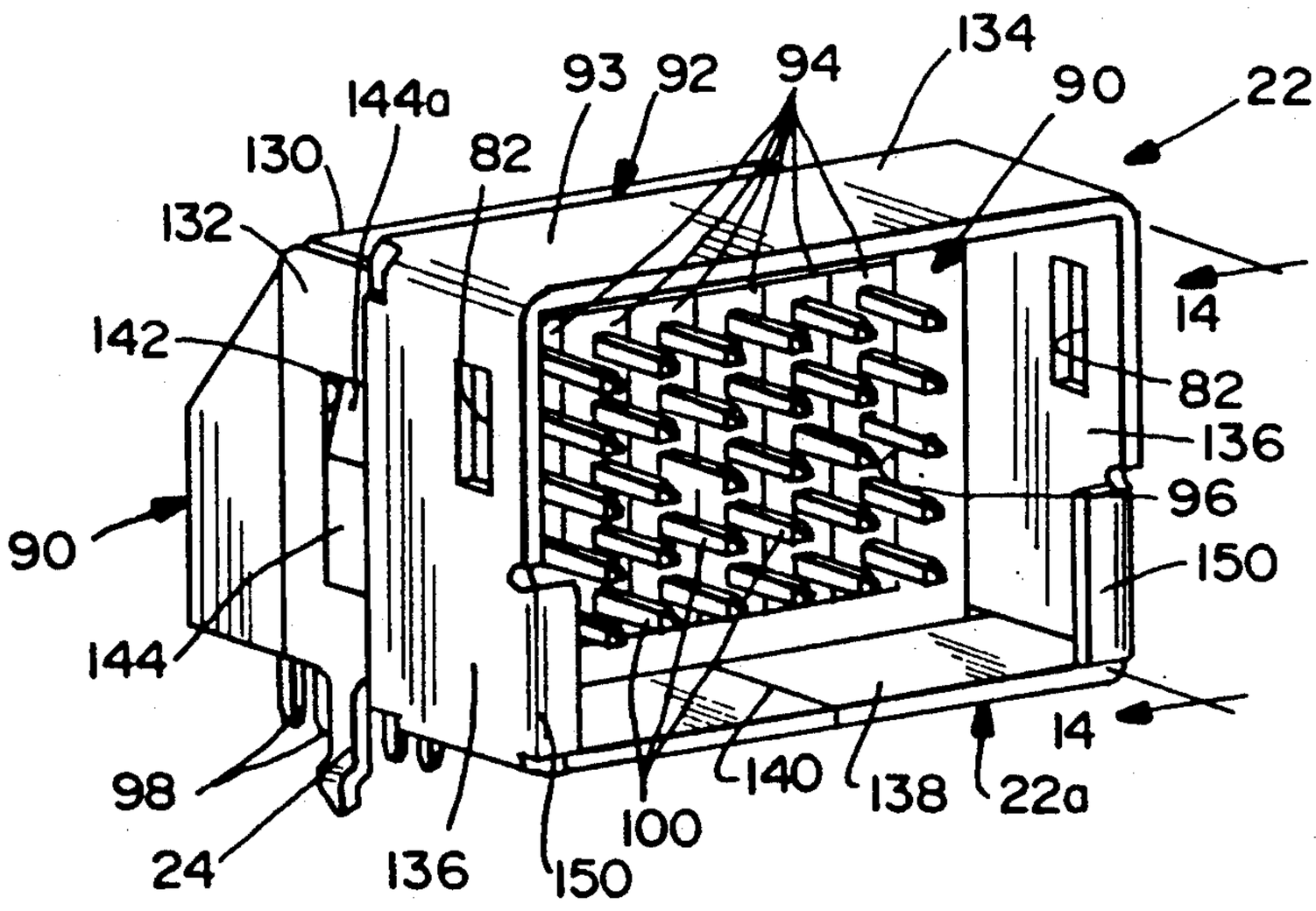

FIG. 1

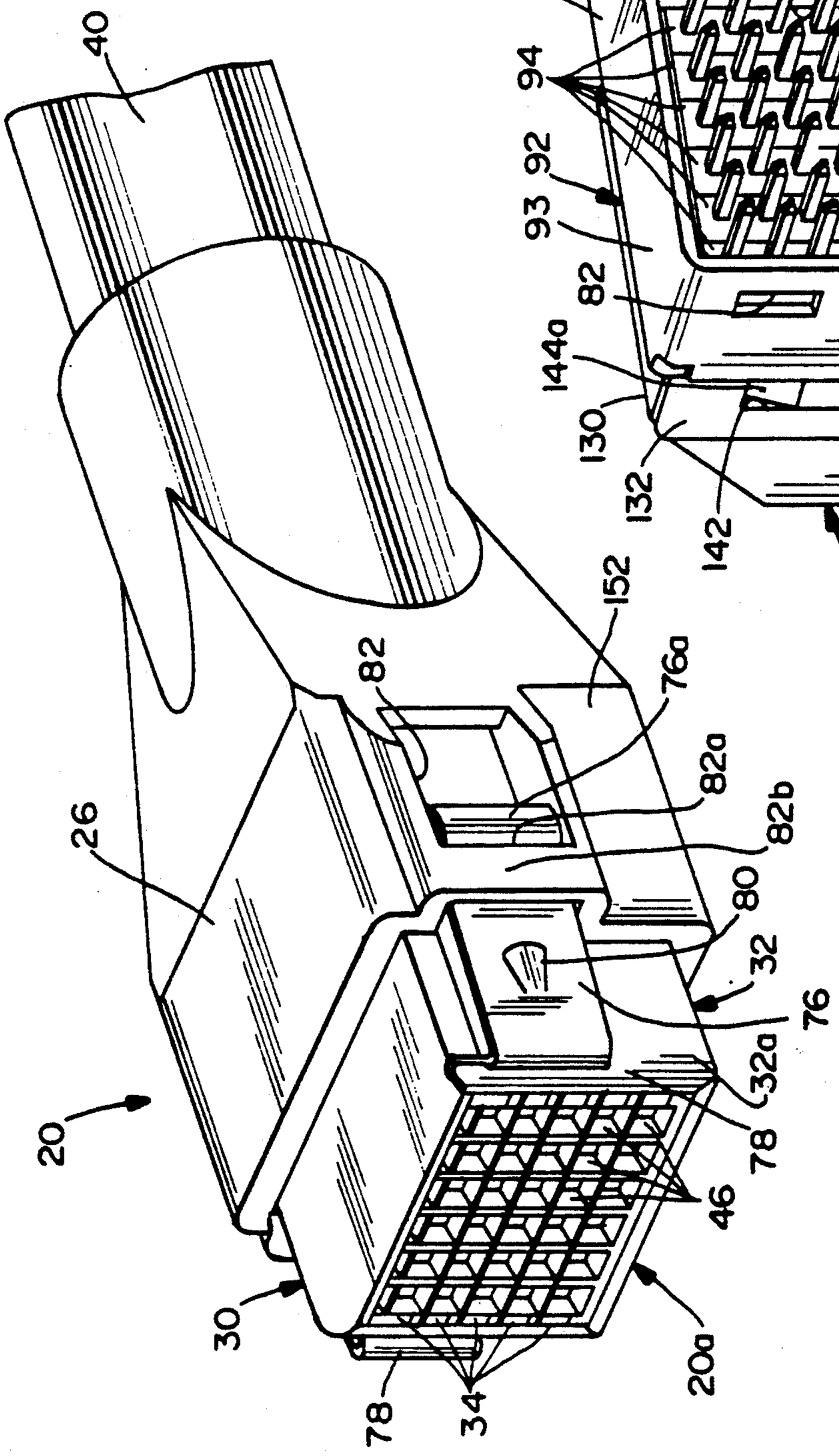
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FIG. 2

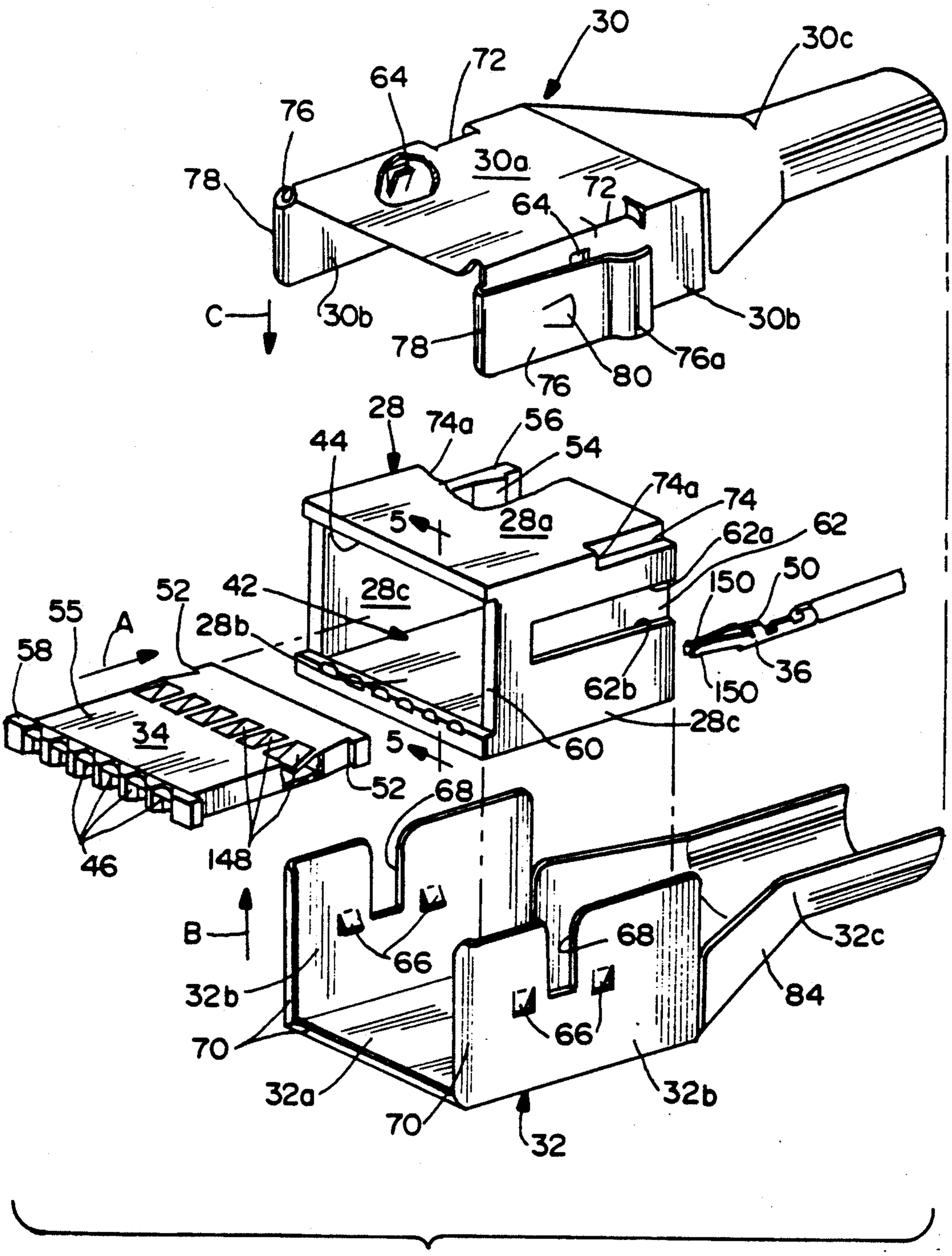
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FIG.3

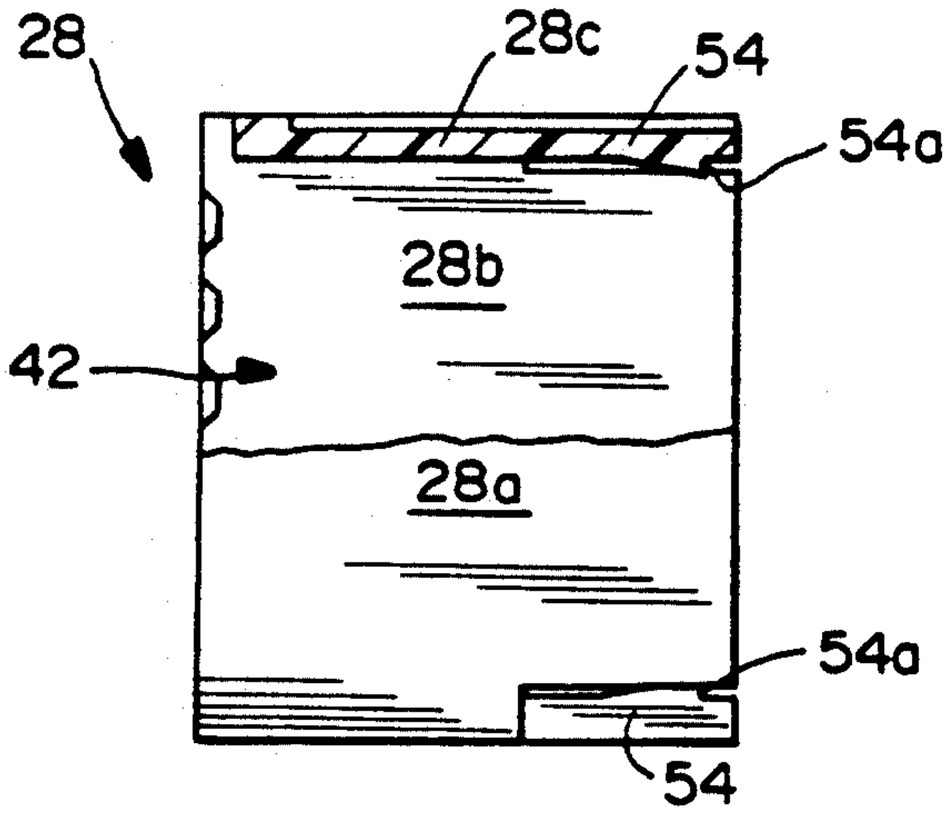


FIG.4

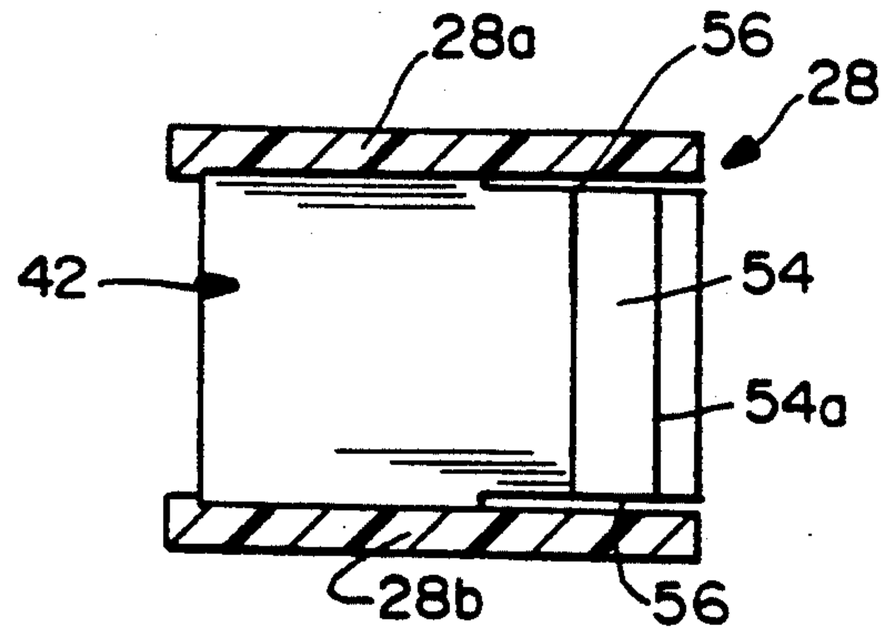


FIG.5

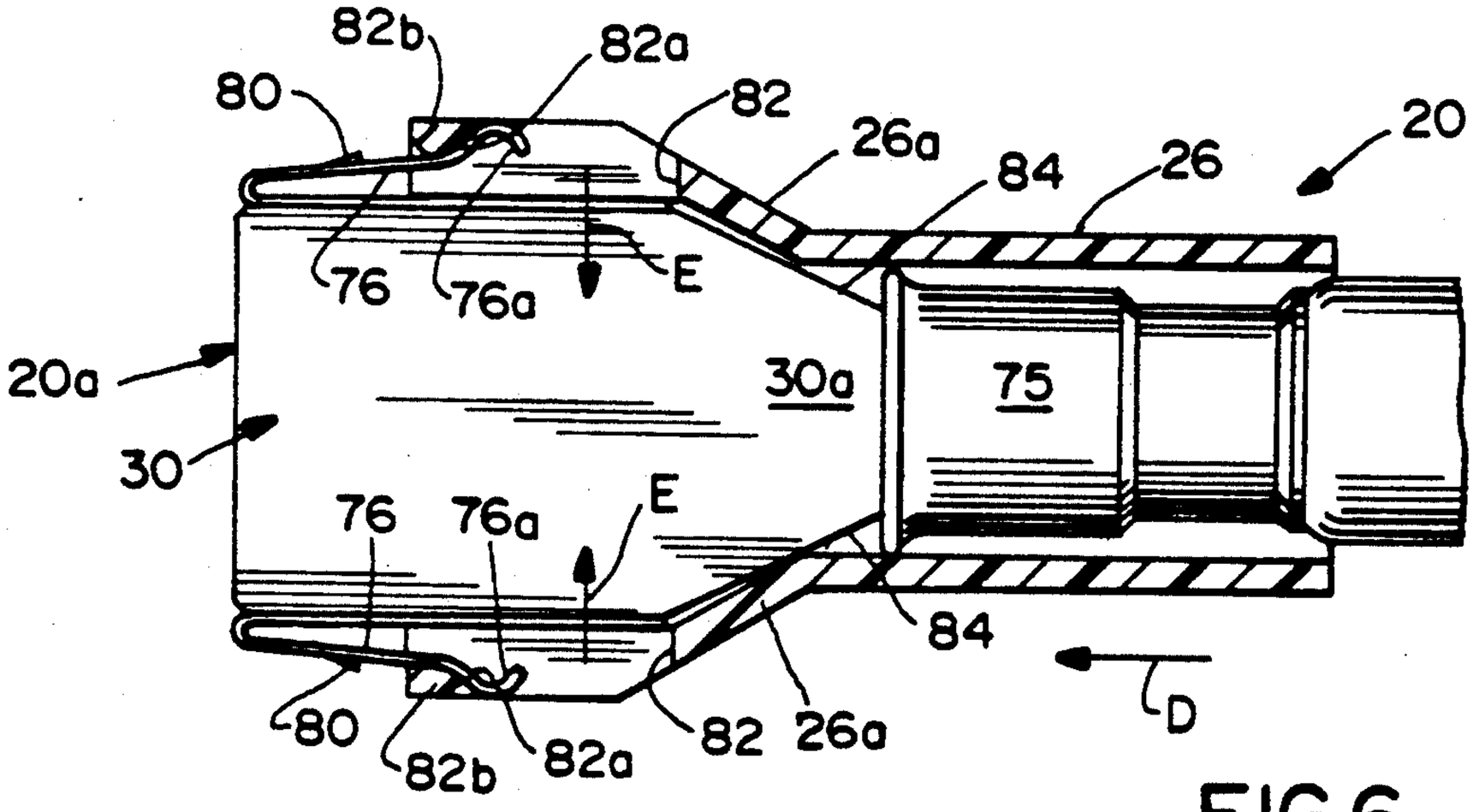


FIG.6

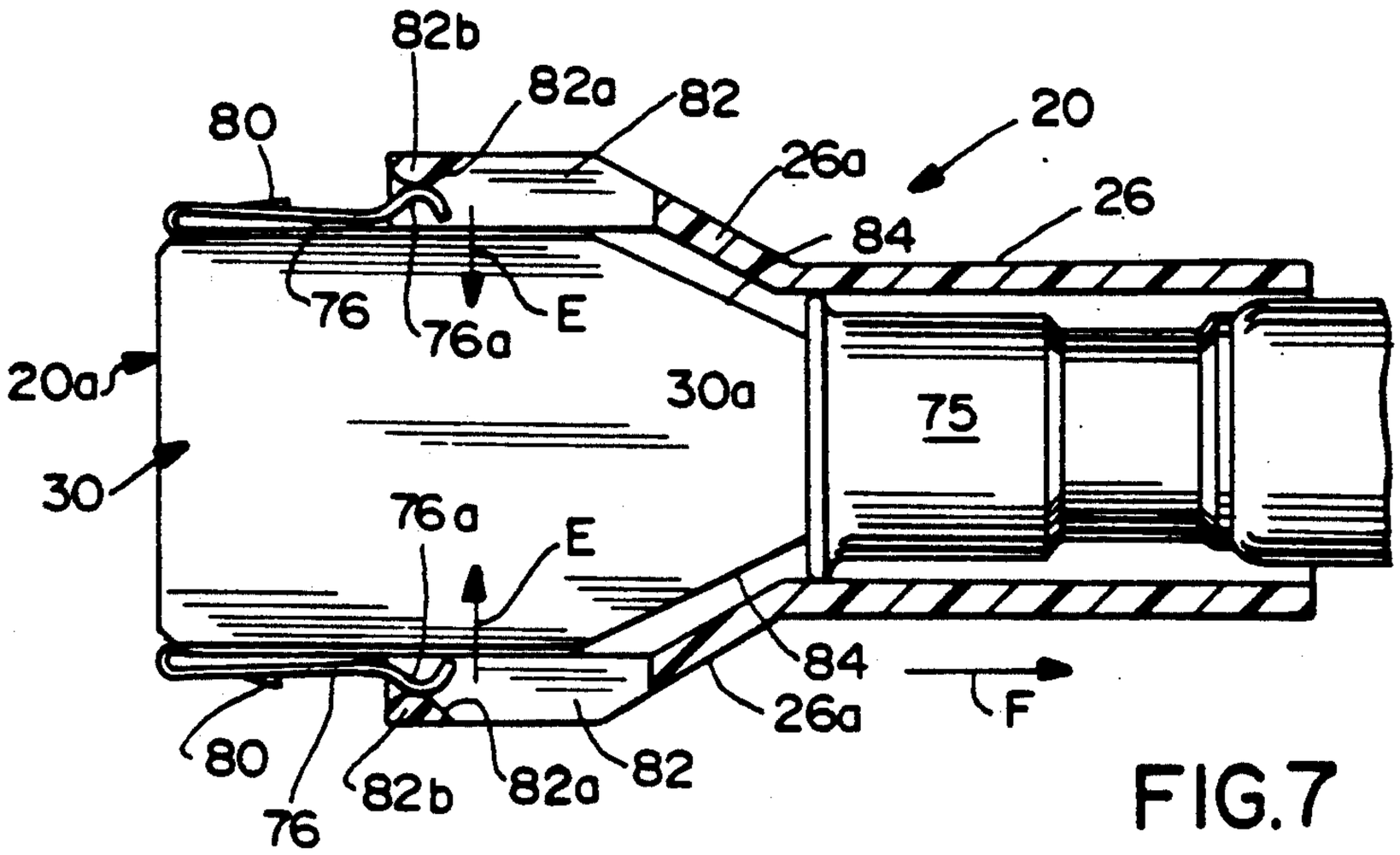
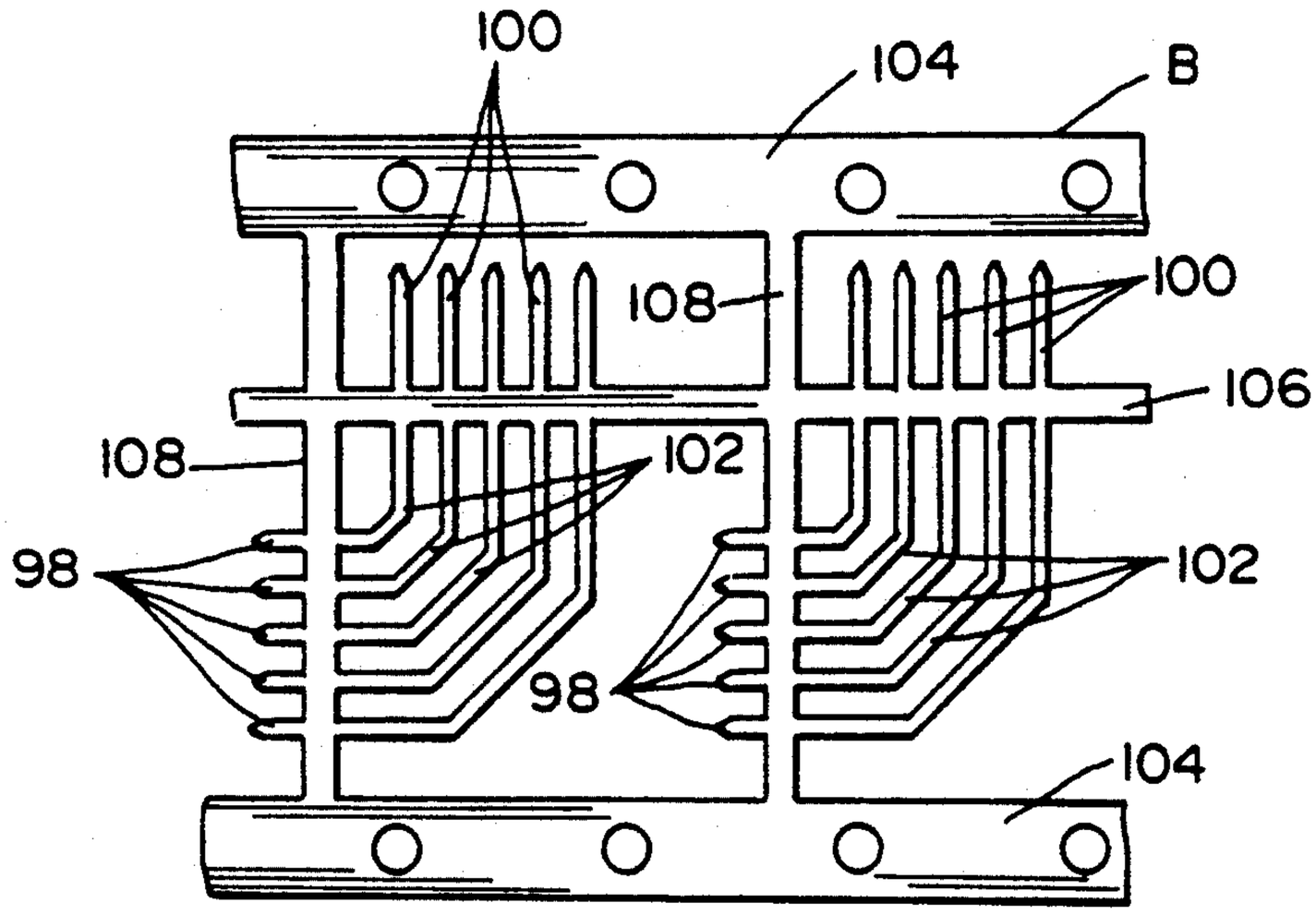


FIG.7



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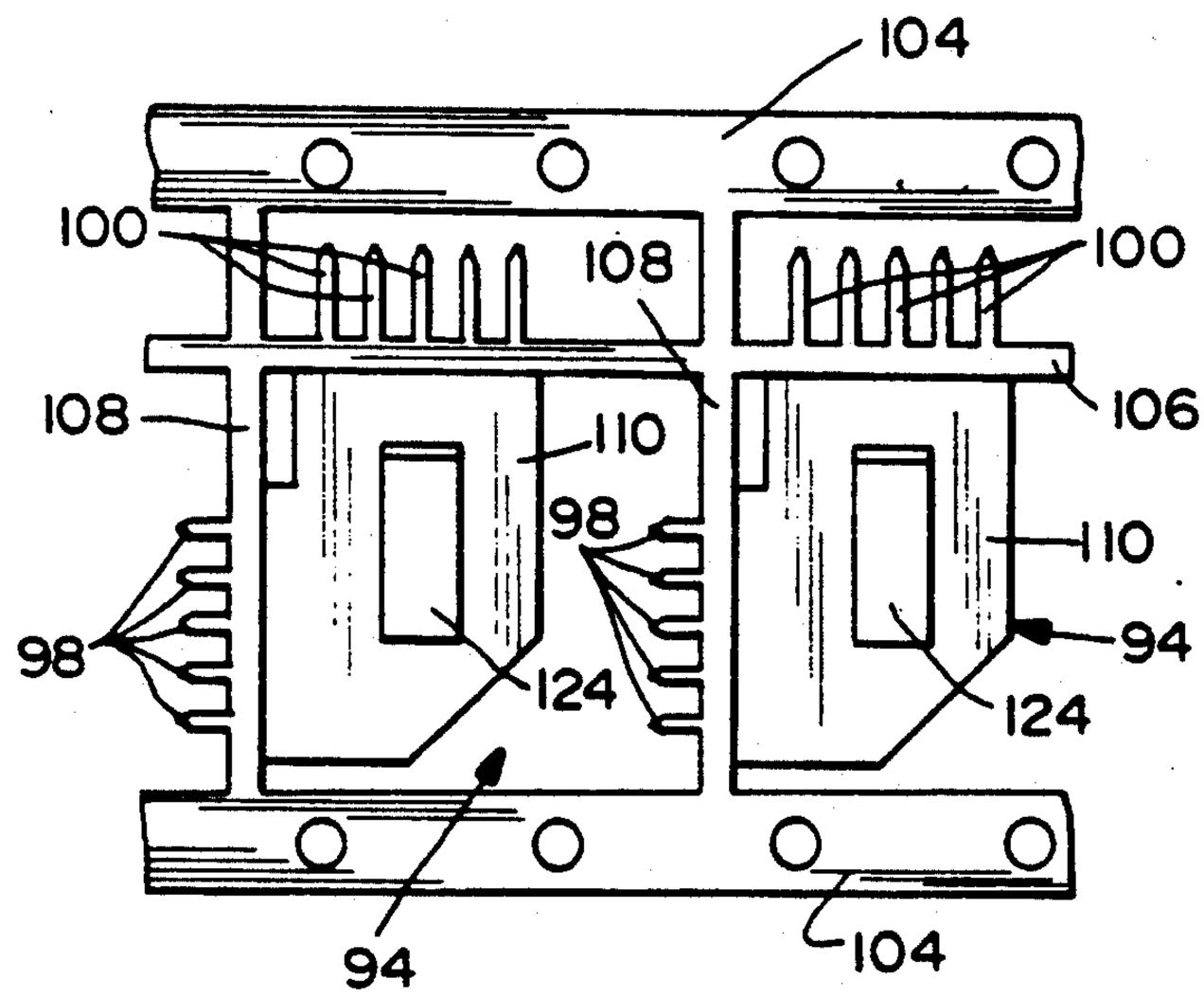

FIG.9

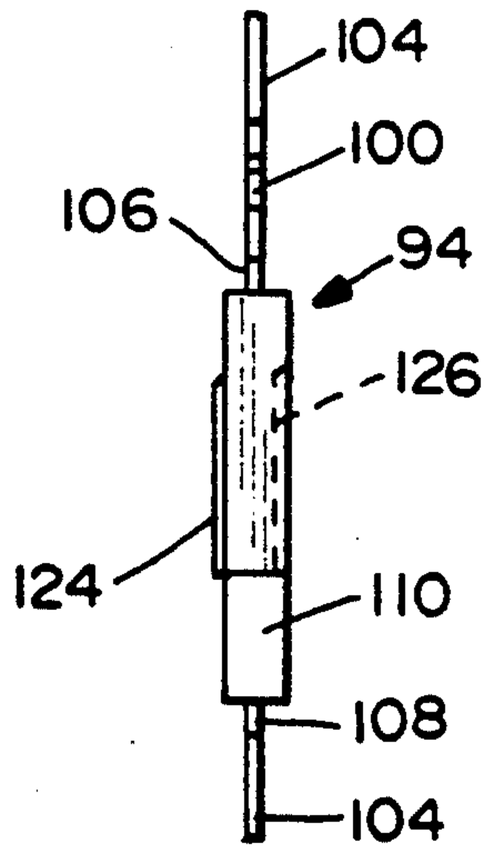

FIG.10

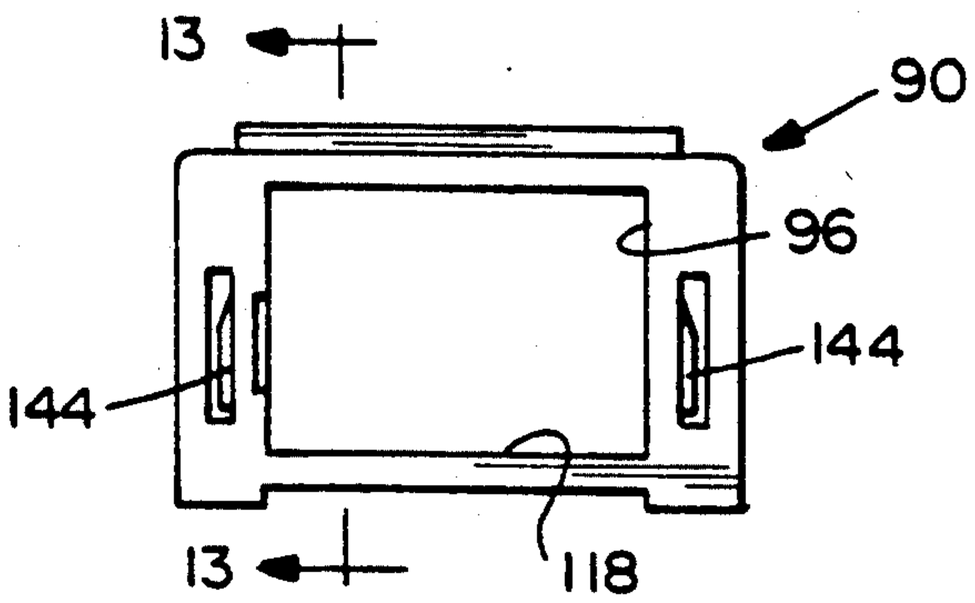

FIG.11

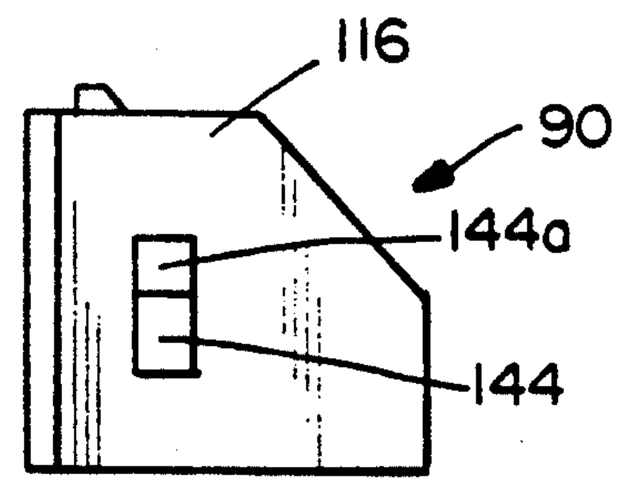

FIG.12

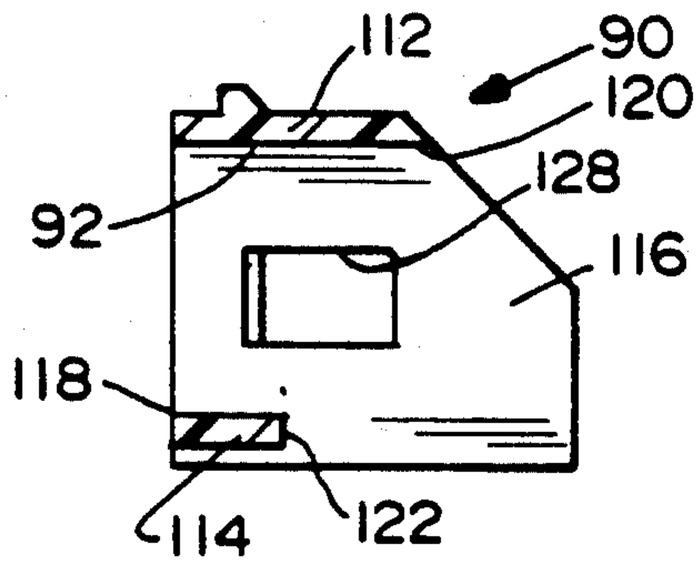

FIG.13

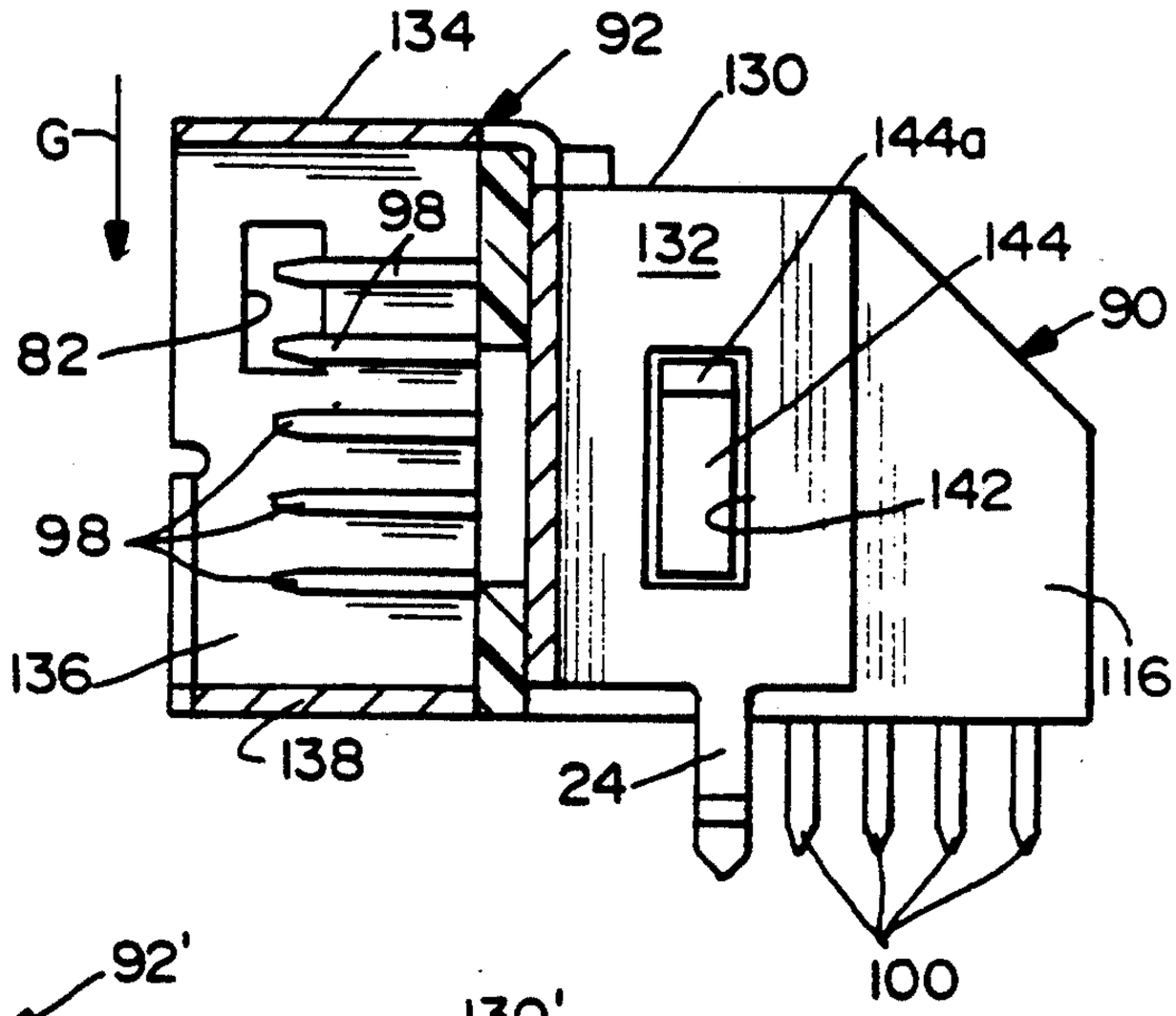

FIG.14

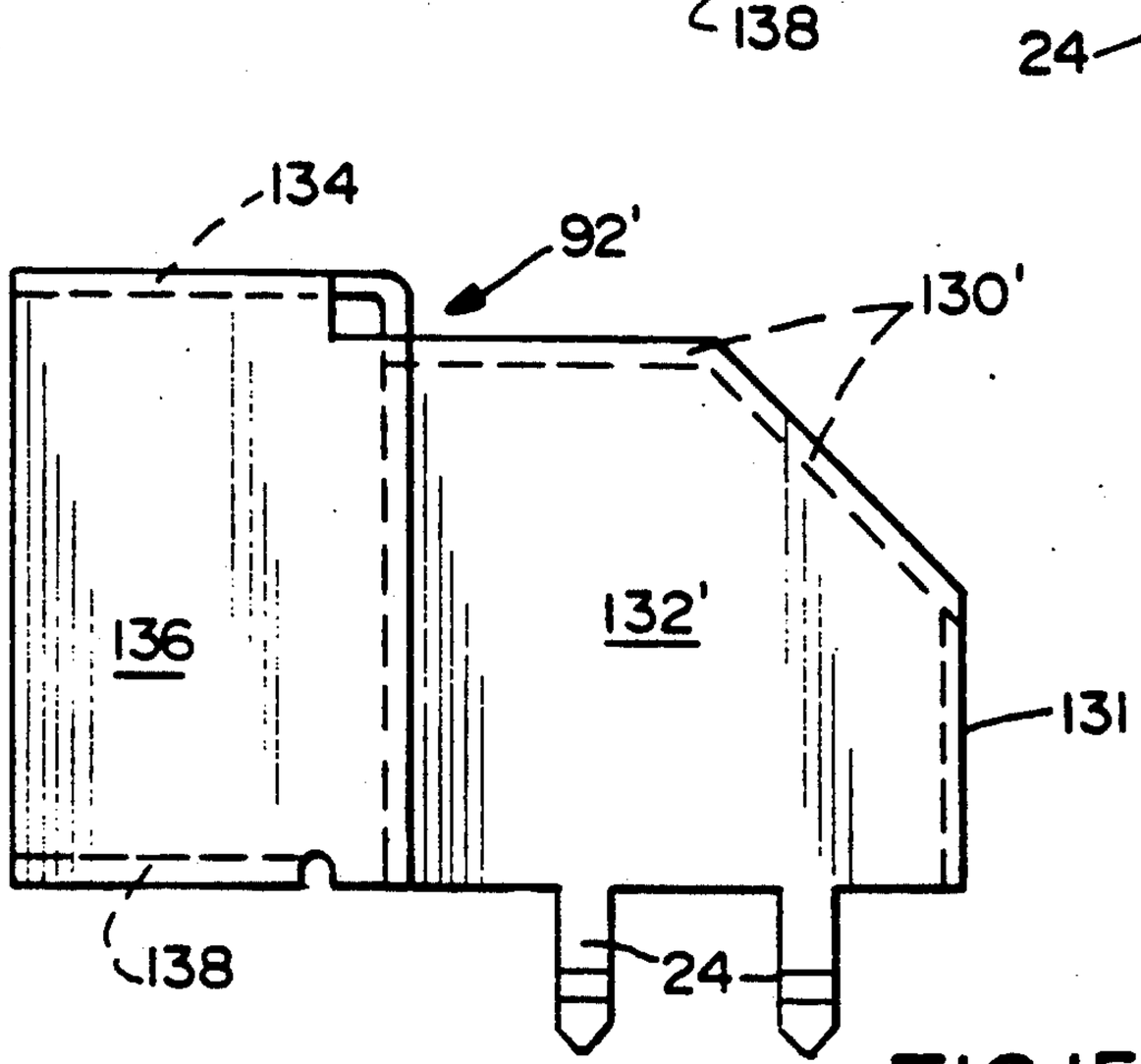

FIG.15

ELECTRICAL CONNECTOR ASSEMBLIES

This is a divisional of copending U.S. Patent application No. 07/879,728 filed Apr. 15, 1992 now U.S. Pat. No. 5,171,161 which is a continuation of U.S. patent application Ser. No. 07/698,746 filed on May 9, 1991 now abandoned.

FIELD OF THE INVENTION

This invention generally relates to the art of electrical connectors and, particularly, to an electrical connector system which includes a plug connector assembly for terminating a multi-conductor cable and a mating right angle connector assembly in the form of a header for connection to a substrate such as a printed circuit board or the like.

BACKGROUND OF THE INVENTION

Electrical connectors have been provided in a wide variety of configurations for terminating multi-conductor cables. With the ever-increasing miniaturization of electrical connectors and the ever-increasing numbers of wires of multi-conductor cables, electrical connectors of the character described have become increasingly complicated in order to accommodate relatively large numbers of conductors terminated in relatively small connectors. This is particularly true when the multi-conductor cable is a shielded cable and, consequently, the electrical connector must have shielding capabilities, such as providing shielding means for the terminals in the connectors as well as terminal portions projecting from the connectors at the interface with a mating connector.

Because of the ever-increasing miniaturization of such electrical connectors, along with their high density terminal configurations, extraneous connector hardware for facilitating assembly of the connector components practically has been made prohibitive, and assembly of the connectors often must be accomplished by interengageable and complementarily configured connector components which are assembled together by elements or parts of the components themselves fitting together in a fixed relationship in final assembly. This becomes very difficult to accomplish and still provide desirable features in the connector, such as various latch means for the connector components, proper shielding for the connector terminals, latch means between mating connectors and the like. Providing a simple electrical connector system of the character described in a modular configuration further complicates the design of the system in high density miniaturized connectors.

This invention is directed to providing an electrical connector system of the character described in a plug and header connector assembly structure which is easy to assemble and reliable in terminating the conductors to respective terminals, the system incorporating a substantially modular design.

SUMMARY OF THE INVENTION

An object, therefore, of the invention is to provide a new and improved electrical connector system for high density applications.

In the exemplary embodiment of the invention, generally, the electrical connector system of the invention includes a shielded modular plug connector assembly and a shielded modular receptacle or header connector assembly, the header connector assembly being disclosed in a right-angled configuration for connection to a substrate such as a printed circuit board or the like.

In the preferred embodiment of the invention, the plug connector assembly includes a housing having an open-ended cavity. A plurality of terminal-receiving modules are sized and shaped to be juxtaposed in a nested array for positioning in the cavity of the housing through one open-end thereof. Complementary interengageable latch means are provided between the housing and each terminal-receiving module to hold all the modules in their nested array in the cavity.

As disclosed herein, the housing of the plug connector assembly and all of the terminal-receiving modules are unitarily molded of dielectric material. The complementary interengageable latch means are provided in the form of a common latch rib disposed on the inside of the cavity of the housing extending along the entire array of modules, and individual latch projections molded on the outside of each module and interengageable with the common latch on the inside of the cavity. The cavity is generally rectangularly shaped, and the modules are elongated with lengths generally equal to one cross-dimension of the rectangular cavity and with widths totalling the opposite cross-dimension of the rectangular cavity.

The plug connector assembly is a shielded electrical connector and includes top and bottom conductive shield sections positionable over the top and bottom, respectively, of the connector housing. Each shield section includes side walls overlying the sides of the housing. Complementary interengageable latch means are provided between the sides of the housing and the side walls of each shield section for holding the shield sections on the housing. In the preferred embodiment of the invention, the connector housing is molded with generally horizontal grooves in each side thereof. The shield sections are fabricated of stamped and formed sheet metal material and include tabs for snapping into the grooves of the housing.

A feature of the invention is the provision of a cover about the plug connector assembly for facilitating mating and unmating of the plug connector assembly with the receptacle or header connector assembly. More particular, one of the shield sections of the plug connector assembly includes at least one latch arm normally biased outwardly of the plug connector assembly. The latch arm is movable between an outwardly biased, operative latching position when the connector assemblies are mated and an inwardly biased, inoperative unlatching position to allow unmating of the connector assemblies. The outer cover is movable relative tot he shield and inner housing of the plug connector assembly in a mating/unmating direction. Complementary engageable cam means are provided between the outer cover and the latched arm for moving the latch arm to the inoperative unlatching position when the cover is moved relative to the connector assembly in the unmating direction, and for allowing movement of the latch arm to the operative latching position when the cover is moved relative to the plug connector assembly in the mating direction.

In the exemplary embodiment of the invention, the receptacle or header connector assembly includes a housing defining a module-receiving cavity. Generally, a plurality of generally flat terminal modules are nested within the cavity in a side-by-side relationship. Each terminal module includes a plurality of generally coplanar flat terminals surrounded and maintained in a de-

sired array by an overmolded module encasement. The terminals have terminal portions projecting from the encasement.

In the preferred embodiment of the invention, the terminals of the header connector assembly are fabricated of stamped and formed sheet metal material. The overmolded modular encasements are fabricated of dielectric material such as molded plastic. The housing includes open ends in generally perpendicular planes to define a right-angled configuration of the header connector assembly. The terminals are configured in right angles with opposite ends projecting from the open ends of the housing. The terminal modules include interengaging locking means molded integrally with opposite sides thereof for holding the modules together in their side-by-side relationship within the cavity in the housing. The housing has locking means at opposite sides of the cavity for locking engagement with the end-most modules of the plurality of modules in the side-by-side relationship within the housing.

The right-angled header connector assembly is a shielded connector. A unitary conductive shield is positioned about the housing and includes a top wall covering at least a portion of the top of the housing, opposite side walls covering at least portions of the respective sides of the housing, and shroud wall means substantially surrounding ends of the terminals which project from the front of the housing. The unitary conductive shield is fabricated in one piece of stamped and formed metal material. Latch means are provided between the housing and the unitary conductive shield to hold te shield on the housing. The front of the housing is generally rectangularly shaped, and the shroud wall means of the unitary conductive shield is formed by four walls defining a rectangular shroud complementary to the rectangular shape of the front of the housing.

A further feature of the invention concerns the terminals in the plug connector assembly and the terminals in the receptacle or header connector assembly. Specifically, the terminals in the plug connector assembly are female terminals each having a pair of generally parallel opposing jaws. The terminals of the header connector assembly are male terminals fabricated of stamped and formed sheet metal material. The invention contemplates that the male terminals be oriented such that the smooth sides of the sheet metal material from which the male terminals are fabricated engage the jaws of the female terminal when the connector assemblies are mated.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. **1** is a perspective view of the plug connector assembly of the electrical connector system of the invention;

FIG. **2** is a perspective view of the right angle receptacle or header connector assembly of the electrical connector system of the invention;

FIG. **3** is an exploded perspective view of the major components of the plug connector assembly of FIG. **1**, with the cover removed to facilitate the illustration;

FIG. **4** is a top plan view, partially in section, of the housing of FIG. **3**;

FIG. **5** is a vertical section taken generally along line **5—5** of FIG. **3**;

FIG. **6** is a horizontal section through the cover of the plug connector assembly in FIG. **1**, illustrating the cover in its mating position allowing the latch means of the connector assembly to move outwardly to its operative latching condition;

FIG. **7** is a view similar to that of FIG. **6**, with the cover moved rearwardly to move the latch means inwardly for unmating the connector assemblies;

FIG. **8** is a plan view of a blank of sheet metal material from which the terminals of the header connector assembly of FIG. **2** are fabricated;

FIG. **9** is a view similar to that of FIG. **8**, illustrating the overmolded encasements for the terminals;

FIG. **10** is an end view, as looking toward the right-hand end of FIG. **9**;

FIG. **11** is a front elevational view of the inner housing of the header connector assembly of FIG. **2**;

FIG. **12** is a side elevational view of the housing of FIG. **11**, as looking toward the right-hand side of FIG. **11**;

FIG. **13** is a vertical section taken generally along line **13—13** of FIG. **11**;

FIG. **14** is a vertical section through the front shroud portion of the shield of the header connector assembly, taken generally along line **14—14** of FIG. **2**, illustrating the rear of the connector assembly in elevational; and

FIG. **15** is a side elevational view of a modified form of shield for the header connector assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in greater detail, and first to FIGS. **1** and **2**, the invention is embodied in an electrical connector system which includes a first connector assembly, generally designated **20** (FIG. **1**), and a second connector assembly, generally designated **22** (FIG. **2**). Connector assembly **20** is in the form of a plug connector assembly, and connector assembly **22** is in the form of a right angle receptacle or header connector assembly. Plug connector assembly **20** includes a plug end, generally designated **20***a* (FIG. **1**), for insertion into a receptacle end, generally designated **22***a* (FIG. **2**), of header connector assembly **22**. The header connector assembly is designed for mounting on a substrate, such as a printed circuit board or the like, and includes board lock legs **24**, as described in greater detail hereinafter.

Referring to FIG. **3** in conjunction with FIG. **1**, plug connector assembly **20** includes a dielectric outer cover **26** (FIG. **1**), an inner dielectric housing, generally designated **28** (FIG. **3**), a top shield section, generally designated **30**, a bottom shield section, generally designated **32**, a plurality of terminal-receiving modules **34** positionable within housing **28**, and a plurality of female terminals **36** mounted within each module **34**. Each terminal **36** is terminated to a discrete electrical wire **38**, as by crimping, and the discrete wires form a multi-conductor cable **40** (FIG. **1**).

As seen best in FIG. 3, inner housing 28 of plug connector assembly 20 includes an open-ended cavity 42 defined by a top wall 28*a*, a bottom wall 28*b* and opposite side walls 28*c*. Cavity 42 defines a front mouth 44 into which modules 34 are inserted in the direction of arrow "A".

Although only one terminal-receiving module 34 is shown in FIG. 3, it can be seen in FIG. 1 that a plurality of the modules are sized and shaped to be juxtaposed in a nested array for positioning in cavity 42 of housing 28 through mouth 44 thereof. Each module 34 has a plurality of channels extending between forward pin-receiving openings 46 to the rear of the module whereby female terminals 36 can be either rear loaded into the modules or loaded from the open side of the channels. When the modules are stacked on top of each other, the top surface 55 of each module encloses the channels of the module 34 above it. Each module has a plurality of latching tabs 48 (FIG. 3) for latching behind shoulders 50 of terminals 36 to hold the terminals in the channels in the modules. Although the precise numbers are not limiting, it can be seen that each module 34 has six pin-receiving openings 46 for receiving six terminals 36. As seen in FIG. 1, five modules 34 are juxtaposed in a stacked array within the connector assembly whereby the forward plug end 20*a* of the connector assembly presents five rows of six pin-receiving openings. It also can be seen in FIG. 3 that each module 34 has individual latch shoulders 52 in opposite sides thereof near the rear of the module.

Referring to FIGS. 4 and 5 in conjuction with FIG. 3, it can be seen that inwardly projecting, vertical ribs 54 extend along the inside of side walls 28*c* of housing 28. These ribs define latching shoulders 54*a* for engagement behind latch shoulders 52 of the modules to hold the modules in the housing. The side walls have horizontal slits, as at 56 (FIG. 5), to provide resiliency for the rear areas of the side walls. Consequently, when modules 34 are inserted into cavity 42 of the housing, the rear portions of the side walls are biased outwardly and, when the modules are fully inserted into the housing, latch shoulders 52 and 54*a* snap into latching engagement. It can be seen in FIG. 3 that each module 34 has a front, outwardly projecting flange 58 which abuts against front edges 60 of side walls 28*c* to define the fully inserted positions of the modules in which latch shoulders 52 and 54*a* are in latching engagement. Each of housing 28 and all of the terminal-receiving modules 34 are unitarily molded of dielectric material, with latch shoulders 52, ribs 54 and latch shoulders 54*a* all being integrally molded with their respective components.

From the foregoing, it can be seen that latch shoulders 52, ribs 54 and latch shoulders 54*a* combine to provide complementary interengaging latch means between housing 28 and modules 34 to hold all of the modules in their nested array within cavity 42 of the housing. Ribs 54 and latch shoulders 54*a* form a common latch means on the housing extending along the entire height of the array of modules for interengagement with the individual latch shoulders 52 of the individual modules. It also can be seen that cavity 42 is generally rectangularly shaped, and the modules are elongated with lengths (widths as viewed in the drawings) generally equal to one cross-dimension of the rectangular cavity, and with the widths (heights as viewed in the drawings) of the modules totalling the opposite cross-dimension of the rectangular cavity.

Still referring to FIG. 3 in conjunction with FIG. 1, terminals 36 are located within modules 34 which, in turn, are disposed within housing 28 and the entire assembly is shielded by top shield section 30 and bottom shield section 32 which are snap-fit onto housing 28. More particularly, groove 62 is molded integrally along the outside of side walls 28*c* of housing 28. The grooves define upper ledges 62*a* and lower ledges 62*b*. The shield sections are fabricated of stamped and formed metal material. Top shield section 30 includes a top wall 30*a* and opposite side walls 30*b*, with a cable shroud portion 30*c* projecting from the rear thereof. Each side wall 30*b* of top shield section 30 includes an inwardly formed tab 64 located for snapping beneath upper ledge 62*a* of slot 62 in the respective juxtaposed side wall 28*c* of housing 28. Similarly, bottom shield section 32 includes a bottom wall 32*a*, opposite side walls 32*b* and a cable shroud portion 32*c* projecting rearwardly of the shield. Side walls 32*b* each include a pair of formed tabs 66 for snapping above lower ledges 62*b* of grooves 62 in the outside of side walls 28*c* of housing 28. Side walls 32*b* of bottom shield section 32 also have cut-out portions 68 in their upper edges for accommodating tabs 64 of top shield section 30, for purposes described below.

In assembly of plug connector assembly 20, bottom shield section 32 is moved upwardly in the direction of arrow "B" (FIG. 3) over housing 28 until tabs 66 snap above lower edges 62*b* of grooves 62 of the housing. The forward edges of bottom wall 32*a* and side walls 32*b* of the bottom shield section are provided with inwardly directed flanges 70 for abutting against the front of housing 28 and the front faces of flanges 58 of modules 34. Once the bottom shield section is snapped into position, top shield section 30 is moved downwardly in the direction of arrow "C", with side walls 30*b* of the top shield section overlying the side walls of the bottom shield section, until tabs 64 snap below upper ledges 62*a* of grooves 62 in the side walls of the housing. Cut-outs 68 in the bottom shield section accommodate movement of tabs 64 in the top shield section to their latched positions beneath upper ledges 62*a*. Top shield section 30 has indented corner portions 72 at the junctures of the top wall and side walls thereof for positioning into recessed areas 74 of housing 28. The forward ends of indented corners 72 abut against a shoulder 74*a* defined by recessed areas 74. It can be seen that the top and bottom shield sections 30 and 32, respectively, combine to completely enclose the top, bottom and sides of housing 28 to shield terminals 36 within modules 34 disposed within cavity 42. Cable shroud portions 30*c* and 32*c* combine to completely surround the interfacing area between multi-conductor cable 40 and its discrete wires 38 which are terminated to terminals 36.

A crimpable collar 75 (FIGS. 6 and 7) is slid over cable 40 when assembly of the connector 20 is initiated. The outer insulation of the shielded cable is stripped away exposing the shielding (not shown) of the cable. After the top 30 and the bottom 32 shield halves are assembled onto housing 28, crimpable collar 75 is slid over the cable shroud portions 30*c* and 32*c* which are in contact with the shielding of the cable. The collar 75 is then crimped in known manner deforming the collar and the cable shroud portions 30*c* and 32*c*.

A feature of the invention is the design of outer cover 26 (FIG. 1) so that the cover is movable relative to the assembled shield sections 30, 32 and housing 28 therewithin; the cover being used to actuate a latching means between plug connector assembly 20 and header con-

nector assembly **22**. More particularly, referring again to FIG. **3** in conjunction with FIG. **1**, top shield section **30** is provided with a pair of latch arms **76** formed integrally with the shield and bent back from the front edges of side walls **30***b*, as at **78**. Each latch arm has a latching tab **80** stamped therein and positioned for snapping engagement within apertures **82** (FIG. **2**) of header connector assembly **22**. The latch arms also have rounded distal ends **76***a* which project outwardly form the body of the latch arms. With the shield section being stamped and formed from sheet metal material, it can be understood that latch arms **76** define spring arms which are self-biased toward their outwardly projecting positions as shown in FIGS. **1** and **3**. As best seen in FIG. **1**, rounded distal ends **76***a* of the latch arms project into side openings **82** of outer cover **26**, behind front edges **82***a* of the openings.

Referring to FIGS. **6** and **7** in conjunction with FIG. **1**, FIG. **6** shows the position of outer cover **26** as illustrated in FIG. **1**. It can be seen that angled walls **26***a* of the cover are in engagement with angled walls **84** of the cable shroud portion of the shield sections. In this position, it can be seen that latch arms **76** are in outwardly projecting, operative latching positions, with rounded distal ends **76***a* of the latch arms projecting into openings **82** in the cover, behind front edges **82***a*. When plug connector assembly **20** is moved in a mating direction, as indicated by arrow "D" (FIG. **6**), an operator will be grasping the outside of cover **26**. With angled walls **26***a* of the cover engaging shields **30** and **32**, the front mating plug end **20***a* of plug connector assembly **20** can be inserted into mating receptacle end **22***a* of header connector assembly **22** (FIG. **2**). Immediately prior to mating, latch arms **76** angle away from side walls **30***b* in the direction A as shown in FIG. **3**. During mating, latch arms **76** will initially contact side walls **136** of header shield **92** and are forced inwards toward side walls **30***b* in the direction "E" (FIG. **6**) to permit the latch arms to enter the header shield. Upon insertion, latching tabs **80** of the latch arms snap into apertures **82** (FIG. **2**) of the header connector assembly.

When an operator wishes to unmate connector assemblies **20** and **22**, the operator grasps cover **26** and pulls on the cover in the direction of arrow "F" (FIG. **7**). The cover moves relative to shield **30** and latch arms **76** until the front edge **82***a* of openings **82** engage rounded distal ends **76***a* of the latch arms. The latch arms thereby are forced inwardly in the direction of arrows "E", moving latching tabs **80** out of apertures **82** whereupon the connectors can be unmated. Cover **26** includes a pair of projections (not shown) on the top and bottom of tis inner surfaces facing shields **30** and **32**, respectively. Upon moving cover **26** in the direction "F", the projections will contact the leading edge **77** of crimpable collar **75** thus preventing the vertical members **82***b* from moving rearwardly past rounded distal ends **76***a* of the latch arms. In essence, the front edge **76***a* of cover **26** and the rounded distal ends **76***a* of the latch arms form complementary engageable cam means between the cover and the latch arms to effect movement of the latch arms to an unlatched position, as shown in FIG. **7**, for unmating the connector assemblies.

Turning now tot he right angle receptacle or header connector assembly **22** (FIG. **2**), the connector assembly includes a dielectric housing, generally designated **90**, unitarily molded of plastic material or the like (FIG. **11**). A unitary conductive shield, generally designated **92**, is fabricated in one piece of stamped and formed sheet metal material (FIG. **1**). A plurality of generally flat terminal modules **94** are nested within a module receiving cavity **96** in housing **90**, the modules being in a vertical side-by-side relationship. Each terminal module **94** includes a plurality of generally coplanar flat terminals surrounded and maintained in a desired array by an overmolded module encasement, as described in greater detail hereinafter. As visible in FIG. **2**, the terminals have terminal pin portions **100** projecting from the modules within a forward shroud portion **93** of shield **92**, and tail portions **98** projecting out of the bottom of the connector assembly for insertion into appropriate holes in a substrate such as a printed circuit board or the like for termination to circuit traces on the board.

FIG. **8** illustrates how the terminals for header connector assembly **22** are mass produced from a stamped blank, generally designated "B", of sheet metal material in strip form. Groups of five terminals **102** are stamped from the blank in right-angled configurations, defining terminal pin portions **100** and tail portions **98** at opposite, right-angularly directed ends of the terminals. The blank includes indexing strips **104** movable through appropriate application stamping tooling, with longitudinal webs **106** and cross webs **108** spanning the groups of terminals and traversing strips **104**, respectively. For purposes described hereinafter, it can be understood that the flat faces or sides of terminals **102** which are stamped from the sides of the sheet metal blank are generally smooth in comparison to the edges of the terminals which are formed by a stamping operation.

FIGS. **9** and **10** illustrate an overmolded encasement **110** which completely surrounds the right-angled terminals **102**, as viewed in FIG. **8**, leaving pin portions **100** and tail portions **98** projecting from the overmolded encasement. After the terminals are overmolded with encasement **110**, webs **106** and **108** are severed in line with the stamped edges of pin portions **100** and tail portions **98**, leaving right-angled terminal modules **94** (FIG. **2**) including the terminals surrounded by the overmolded encasements.

Comparing FIGS. **9** and **10** with FIG. **2**, it can be seen that terminal modules **94** are nested within cavity **96** of housing **90** in an array of six vertical modules of five terminals in a side-by-side relationship for insertion into the corresponding row-array of pin-receiving openings **46** in plug connector assembly **20** (FIG. **1**).

FIGS. **11–13** show the configuration of housing **90** of header connector assembly **22**, including module receiving cavity **96** (FIGS. **11** and **13**). The housing is unitarily molded of dielectric material and includes a top wall **112**, a bottom wall **114** and opposite side walls **116**. The front of the housing is open, as at **118**, and through which terminal pin portions **100** project. The rear of the housing is open, as at **120**, and the bottom of the housing is partially open, as at **122**, for insertion of right-angled modules **94** into the housing with terminal tail portions **98** projecting out of the bottom of the housing for mounting in appropriate holes in the printed circuit board.

Complementary interengaging locking means are provided on opposite sides of terminal modules **94** for holding the modules together in their side-by-side relationship within cavity **96** of housing **90**. Specifically, as seen in FIGS. **9** and **10**, one side of each encasement **110** is provided with a projecting boss **124** and the opposite side of each encasement is provided with a complemen-

tarily shaped indented recess **126** (FIG. **10**). The bosses and detents are rectangularly shaped such that when the terminal modules are juxtaposed in their side-by-side relationship, the bosses of the modules project into the recesses of adjacent modules, thereby locking all of the modules together. In addition, side walls **116** of housing **90** may be molded with a recess **128** (FIG. **13**) for the left-hand side wall and a boss (not shown) for the right-hand side wall for locking the interlocked modules within the housing.

Referring to FIG. **14** in conjunction with FIG. **2**, unitary conductive shield **92** includes a top wall **130** for covering a portion of the top dielectric housing **90**, opposite side walls **132** for covering portions of side walls **116** of the housing and a generally rectangular shroud wall means **93** substantially surrounding the terminal pin portions **100** of terminals **102** that project from the front of the housing. Specifically, as seen from the above description, the front of dielectric housing **90** is generally rectangular in shape. The shroud wall means **93** of unitary conductive shield **92** includes four walls in the form of a top wall portions **134**, opposite side wall portions **136**, and a bottom wall portion **138**. These wall portions combine to define a rectangular shroud complementary in shape and projecting from the rectangular front of housing **90** and surrounding the projecting pin portions **100** of terminals **102**. Conductive shield **92** is fabricated in one piece from sheet metal material, and bottom wall portion **138** of the terminal pin shroud actually is fabricated by two sections meeting at a seam line **140** (FIG. **2**).

When assembled, unitary conductive shield **92** of header connector assembly **22** is mounted onto dielectric housing **22**. The shield simply is positioned onto the top of the housing, generally in the direction of arrow "G" (FIG. **14**), and latch means are provided between the housing and the shield to hold the shield on the housing. The latch means is provided in the form of apertures **142** in side walls **132** of the shield for receiving outwardly projecting bosses **144** projecting outwardly from side walls **116** of the housing. It can be seen that the top portions of bosses **144** are chamfered, as at **144***a*, to guide the shield side walls over the bosses and allow the side walls to snap into abutment with the sides of the housing once apertures **142** come into registry with bosses **144**.

FIG. **15** somewhat schematically illustrates an alternative unitary shield, generally designated **92'**, which has an angled top wall **130'**, backwall **131** and side walls **132'** for covering substantially the entirety of the top, back and opposite sides of dielectric housing **90**. It also has a second board lock leg **24** located on each side of the housing. Otherwise, like numerals have been applied to the shield corresponding to like portions or walls thereof described in relation to shield **92** (FIGS. **2** and **14**).

Polarization of the plug and receptacle assembly is provided by fingers **150** integrally formed at the front of side wall **136** and adjacent bottom wall **138** of shield shroud **93**. Dielectric outer cover **26** of plug **20** includes stepped portions **152** on each side adjacent the bottom portion of the plug. The width of the cover at the stepped portions is less than the width of the upper portion of the plug and such reduced width is slightly less than the distance between finger **150** to permit insertion of the plug into the receptacle when properly oriented. If the plug were attempted to be inserted upside down in to the receptacle, the latch arms **76** which are located above the center point of the plug or vertical member **82***b* would contact finger **150** thus preventing mating of the connectors.

Finally, a feature of the right angle header connector assembly **22**, particularly in the orientation of terminal modules **94** and terminals **102**, is to orient the terminals whereby smooth flat sides of projecting terminal pin portions **100** engage corresponding smooth portions of terminals **36** (FIG. **3**). More particularly, terminal **36** is a female terminal defined by a pair of opposing beams **150**. Each terminal **36** is fabricated of stamped and formed sheet metal material, whereby beams **150** comprise generally parallel portions of the smooth sides of the sheet metal from which the terminal is stamped and formed. In comparing terminal-receiving modules **34** of plug connector assembly **20** (FIG. **1**) with terminal modules **94** of header connector assembly **22** (FIG. **2**), it can be seen that terminal-receiving modules **34** are in an array of five horizontal modules of six terminals, whereas terminal modules **94** are in an array of six vertical modules of five terminals. In this manner, it can be understood from the description of fabricating modules **94** in relation to FIGS. **8** and **9**, that the smooth sheet metal sides of terminal pin portions **100** engage the smooth sheet metal sides of jaws **150** of female terminals **36**. Therefore, the contacting surfaces between the male and female surfaces cause less wear to plating materials on the terminals during mating and unmating of the connector assembly.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

I claim:

1. An electrical connector system, comprising:

a first connector assembly including a first housing having therein a plurality of female terminals fabricated of sheet metal material having opposed generally planar smooth surfaces and perpendicular edges, each terminal having a pair of opposed contact surfaces thereon formed from said smooth surfaces of said sheet metal material; and

a second connector assembly for connection with the first connector assembly and including a second housing having therein a plurality of male terminals for mating with the female terminals, the male terminals being fabricated of sheet metal material having opposed generally planar smooth surfaces and perpendicular edges so that each said male terminal has a pair of opposed surfaces formed form said smooth surfaces, and the male terminals being oriented in the second housing such that the opposed surfaces of said male terminals engage the opposed contact surfaces of the female terminals when the connector assemblies are mated, said second connector assembly including a plurality of male terminal modules secured to said second housing, each said module including an overmolded dielectric encasement with opposite ends of said male terminals extending from said encasement.

2. The electrical connector system of claim **1** wherein said female terminals include opposed cantilevered contact beams and said contact surfaces are located on said opposed cantilevered contact beams of the female

terminals that are generally parallel and said contact surfaces are generally parallel to the opposed smooth surfaces of the male terminals.

3. The electrical connector system of claim 1 wherein said first connector assembly includes a plurality of female terminal modules secured to said first housing, each said female terminal module being oriented generally perpendicular to the male terminal modules of said second connector assembly.

4. A shielded right-angled electrical connector assembly for mounting to a circuit board, comprising:

a dielectric housing having a top, a bottom, a front, a rear and opposite sides, the front of the housing being generally rectangular in shape, and with a plurality of terminals mounted within the housing, the terminals having opposite ends projecting from the front and from the bottom of the housing; and

a unitary conductive shield fabricated in one piece from stamped and formed sheet metal material, the shield including a top wall covering at least a portion of the top of the housing, opposite side walls covering at least portions of respective sides of the housing and shroud wall means substantially surrounding the ends of the terminals that project from the front of the housing, the shroud wall means being formed by a top wall, a bottom wall and a pair of opposed side walls defining a rectangular shroud complementary in shape to and projecting from the rectangular front of the housing about the ends of the terminals projecting from the front of the housing, said shield further including latching means on said opposed side walls of said shroud for latching with a mating connector assembly and at least one projection integral with and extending from one of said opposed side walls of said shroud towards the other side wall for polarizing said assembly with a mating connector assembly.

5. The shielded right-angled electrical connector assembly of claim 4, including latch means between the dielectric housing and the unitary conductive shield to hold the shield on the housing.

6. The shielded right-angled electrical connector assembly of claim 4 wherein said housing includes a plurality of modules secured thereto, each said module including an overmolded dielectric encasement with opposite ends of said terminals extending from said encasement.

7. The shielded right-angled electrical connector assembly of claim 4 wherein said top wall and opposite side walls of the unitary conductive shield cover substantially the entirety of the top and opposite sides, respectively, of the housing.

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